

What we claim is:

1. A slot antenna array that is excited by a communication signal to determine the number of stacked objects, comprising:
  - a conductive section having a top end and a bottom end; and
  - said conductive section having a plurality of slots substantially the same length and filled with a non-conductive material; and
  - said plurality of slots are individually excited with the communication signal to determine the number of the stacked objects.
2. The slot antenna array of claim 1, wherein said plurality of slots are spaced apart at equal distances from each other.
3. The slot antenna array of claim 1, wherein each of said plurality of slots are spaced apart at a distance substantially equal to the height of one of said stacked objects.
4. The slot antenna array of claim 1, wherein each of said plurality of slots is substantially the same in length as the width of said conductive section.
5. The slot antenna array of claim 1, wherein said non-conductive material is comprised from the group consisting of air and epoxy.

6. The slot antenna array of claim 1, wherein said conductive section has a width and a depth and said plurality of slots includes a bottom slot and a top slot that are located at a distance from said bottom end and said top respectively that is substantially the same said depth.

7. The slot antenna array of claim 6, wherein said depth is around about 82 millimeters and the width of said plurality of slots is around about 164 millimeters.

8. The slot antenna array of claim 7, wherein the width of each of said plurality of said slots is between about 3 millimeters and 10 millimeters.

9. The slot antenna array of claim 6, wherein said the length of each of said plurality of said slots is substantially the same in length as the width of said conductive section.

10. The slot antenna array of claim 1, wherein the operating frequency of said plurality of slots is comprised from the group consisting of around about 869 MHZ and 915 MHZ.

11. The slot antenna array of claim 1, wherein at least two slots in said plurality of slots are each included in angled faces in said conductive section.

12. An interrogation reader and antenna system adapted to individually communicate with stacked objects, comprising:

an antenna array having a plurality of antennas;

a switch; and

a communication electronics that provides energy to said switch;

said switch coupled to said antenna array to selectively excite one or more of said antennas in said antenna array corresponding to select ones of said plurality of slots.

13. The interrogation reader of claim 12, wherein said antenna array is comprised of a slot array;

14. The interrogation reader of claim 13, wherein said slot array is formed by a conductive section filled having a plurality of slots filled with a non-conductive material.

15. The interrogation reader of claim 12, further comprising an energy source.

16. The interrogation reader of claim 15, wherein said energy source is rechargeable.

17. The interrogation reader of claim 12, further comprising a coaxial cable containing wire to coupled said switch to said antenna array.

18. The interrogation reader of claim 12, wherein said switch is comprised of a PCB that contains a communications port for controlling energy to said antenna array.

19. The interrogation reader of claim 12, further comprising a controller that is coupled to said switch to control the coupling of said energy to an antenna in said antenna array.

20. The interrogation reader of claim 19, wherein said controller further comprises a data bus that is connected to said antenna array to address each of said antennas in said antenna array individually to control which of said antenna are excited.

21. The interrogation reader of claim 12, wherein said switch is reactively coupled to said antenna array.

22. The interrogation reader of claim 19, wherein said controller causes said communication electronics to send lower power to said antenna array in a first mode to detect the presence of an external device and said controller causes said communication electronics to send high power to said antenna array in a

second mode when a external device is detected to communicate with said external device.

23. The interrogation reader of claim 22, wherein said lower power is around about one milliWatt and said high power is around about one Watt.

24. The interrogation reader of claim 22, wherein said controller measures the energy received by said communication electronics in response to the energy transmitted by said communication electronics to detect an external device.

25. The interrogation reader of claim 19, further comprising at least one proximity sensor that is placed in proximity to said antenna array to detect said external device placed in proximity to at least one of said plurality of slots.

26. The interrogation reader of claim 25, wherein said proximity sensor is comprised from the group consisting of an optical sensor, an ultrasonic sensor, a microwave sensor, and a magnetic sensor.

27. The interrogation reader of claim 25, wherein said controller records an error condition if said proximity sensor detects said external device and said antenna array does not detect a wireless communication device attached to said external device.

28. The interrogation reader of claim 27, wherein said controller reports said error condition to reporting system.

29. The interrogation reader of claim 19, further comprising a proximity sensor that emits a signal to said controller and wherein said controller controls power to said communications electronics based on said signal.

30. The interrogation reader of claim 29, further comprising a number of proximity sensors equal to the number of said antennas in said antenna array wherein said each of said proximity sensor is placed in correlation to each of said antennas.

31. The interrogation reader of claim 12, wherein the interrogation reader communicates information concerning the wireless communication devices to reporting system.

32. The interrogation reader of claim 31, wherein said reporting system is located remote from the interrogation reader.

33. A cargo transportation communication system adapted to transport one or more objects having wireless communication devices, comprising:

a moveable arm adapted to carry one or more wireless communication devices;

an interrogation reader attached to said movable arm;

an antenna array attached to said moveable arm and aligned in the same direction as the objects; and

said interrogation reader coupled to said antenna array to form one or more antennas to communicate with said objects.

34. The system of claim 33, wherein said antenna array is a slot array.

35. The system of claim 34, wherein said slot array is comprised out of a plurality of slots.

36. The system of claim 33, wherein said antenna array is attached to one plane of said moveable arm.

37. The system of claim 36, wherein said antenna array is aligned in a vertical direction.

38. The system of claim 36, wherein said moveable arm is comprised from the group consisting of a forklift arm, a crane scoop, and a back-ho arm.

39. A forklift adapted to carry one or more stacked pallets containing wireless communication devices, comprising:

a body;

at least one moveable arm that moves with respect to said body and is attached to said body to carry the pallets;

a interrogation reader attached to one of said at least moveable one arm;  
and

an antenna array attached to said one of said at least one moveable arm;  
said interrogation reader coupled to said antenna array to form one or more antennas to communicate with the stacked pallets.

40. The forklift of claim 39, wherein antenna array is a slot array consisting of a conductive section having a plurality of slots aligned in a vertical direction.

41. A method of communicating with stacked objects containing wireless communication devices, comprising the steps of:

activating a switch to provide a coupling to at least antenna in an antenna array;

exciting said at least antenna with energy; and

radiating the energy from said at least antenna to the stacked objects.

42. The method of claim 41, wherein said exciting further comprises providing a low energy to said at least one antenna to determine if the stacked object is present proximate to said at least one antenna.



43. The method of claim 42, wherein said exciting further comprises providing a high energy to said at least antenna to communicate to the stacked object that is determined to be located proximate to said at least one antenna.

44. The method of claim 41, further comprising receiving back reflected radiated energy from the staked object to determine if a stacked object is located proximate to said at least one antenna.

45. The method of claim 44, further comprising determining the height of the stacked objects by comparing the energy radiated to the stacked object device to the energy received back from the stacked object.

46. The method of claim 41, wherein said activating a switch comprises addressing said at least one antenna to select said at least one antenna for said exciting step.

47. A method of communicating with stacked objects containing a wireless communication device, comprising the steps of:

sensing the height of the stacked objects using a proximity sensor; and

exciting a number of antennas in an antenna array arranged in relation to the height of the stacked objects to communicate to the wireless communication devices on the stacked objects.

48. The method of claim 47, further comprising receiving communication back from the wireless communication devices.

49. The method of claim 48, further comprising recording an error condition if the wireless communication device does not communicate in response to the radiated energy.

50. The method of claim 49, further comprising reporting said error condition to reporting system.

51. The method of claim 49, further comprising reporting said error condition over a network to a remote system.

52. A method of determining the height of stacked objects containing wireless communication devices, comprising the steps of:

- (a) selecting a first slot in a plurality of slots aligned in a vertical direction;
- (b) radiating energy from said selected slot to the wireless communication device;
- (c) receiving a signal from the wireless communication device in response to the radiated energy; and
- (d) selecting the next slot in said plurality of slots and repeat steps (b) – (c) for each said next slot until all slots in said plurality of slots are selected.